28ο ΠΑΝΕΛΛΗΝΙΟ Πνευμονολογικό ΣΥΝΕΔΡΙΟ

Διαβρογχική-κατευθυνόμενη διαγνωστική προσπέλαση περιφερικών πνευμονικών βλαβών

Νίκος Κουφός MD, ECFMG, PhD

Πνευμονολόγος – Φυματιολόγος

«Mediterraneo Hospital»

Γλυφάδα, Αθήνα.

Tel.: +30 2106403267

Email: koufos_nikos@hotmail.com

Conflict of interest disclosure

- ☑ I have **no**, real or perceived, direct or indirect conflicts of interest that relate to this presentation.
- ☐ I have the following, real or perceived direct or indirect conflicts of interest that relate to this presentation:

Affiliation / financial interest	Nature of conflict / commercial company name
Tobacco-industry and tobacco corporate affiliate related conflict of interest	
Grants/research support (to myself, my institution or department):	
Honoraria or consultation fees:	
Participation in a company sponsored bureau:	
Stock shareholder:	
Spouse/partner – conflict of interest (as above):	
Other support or other potential conflict of interest:	

Στρατηγική

- Υπολογισμός πιθανότητας κακοήθειας (κλινική & ακτινολογική)
- Αλγοριθμική αξιολόγηση επιλογών
- Διαθέσιμες τεχνικές – Υπέρ & κατά
- Σεβασμός στην επιθυμία του ασθενή

CHEST 2013; 143(5)(Suppl):e93S–e120S

Υπολογισμός κλινικής πιθανότητας κακοήθειας

- Brock University Calculator
- Solitary Pulmonary Nodule Malignancy Risk (Mayo Clinic model)
- NPS-BIMC (Bayesian Inference Malignancy Calculator)

κ.α.

BIMC Web Calculator
<Institute> 2009-2014

<LOGO>

Prior Probability of Malignancy (1-99%)	50

Estimated prevalence of disease in the referred population

Age:	50-59
Smoking (Pack-years)	< 40
Hx Prev Malig:	No
Size (cm)	11-15 mm
Location	Superior
Edges	Lobulated
Volume Doubling Time (VDT)	401-900 d
Minimum Focal Density	< -60 HU
Enhancement>	< 15 HU
FDG-PET	SUV < 1
Probability of Malignancy	3 %

Get BIMC result | Reset

Web Calculator version: v1

BIMC Web Calculator
<Institute> 2009-2014

<LOGO>

Prior Probability of Malignancy (1-99%)	50

Estimated prevalence of disease in the referred population

Age:	50-59
Smoking (Pack-years)	< 40
Hx Prev Malig:	No
Size (cm)	11-15 mm
Location	Superior
Edges	Lobulated
Volume Doubling Time (VDT)	25-400 d
Minimum Focal Density	< -60 HU
Enhancement>	< 15 HU
FDG-PET	SUV < 1
Probability of Malignancy	16 %

Get BIMC result | Reset

Web Calculator version: v1

Αλγοριθμική εκτίμηση

2005: Fleischner Society Guidelines for management of **solid nodules**

2013: Fleischner Society Guidelines for management of **sub-solid nodules**

2017: Guidelines for Management of **Incidental Pulmonary Nodules** Detected on CT Images

Α. Συμπαγείς όζοι: I. Μονήρης όζος ή πολλαπλοί όζοι

II. Χαμηλής πιθανότητας για κακοήθεια

Υψηλής πιθανότητας για κακοήθεια

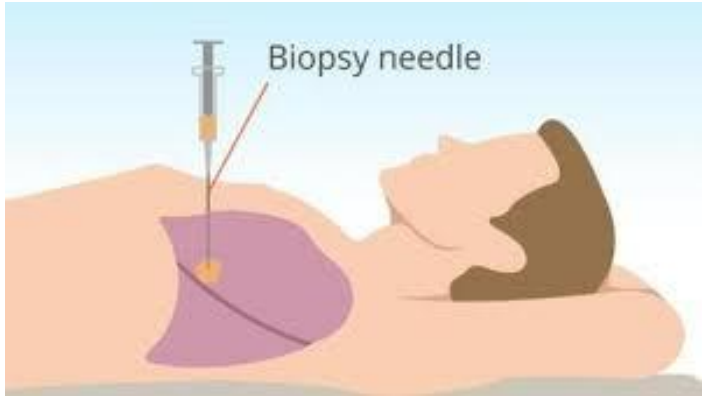
III. Μέγεθος: <6mm 6-8mm >8mm

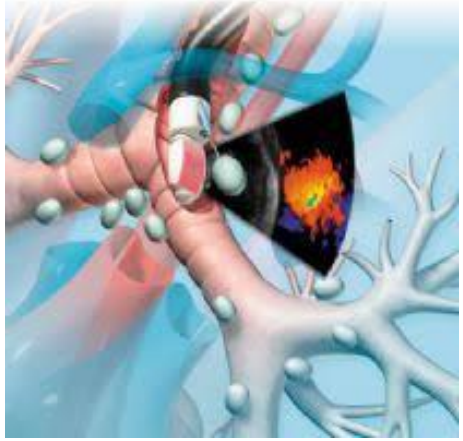
Β. Υπο-συμπαγείς όζοι: I. Μονήρης όζος (αμιγώς ή μερικώς ground glass) ή πολλαπλοί όζοι

II. Χαμηλής πιθανότητας για κακοήθεια

Υψηλής πιθανότητας για κακοήθεια

III. Μέγεθος: <6mm ≥6mm


Biopsy needle

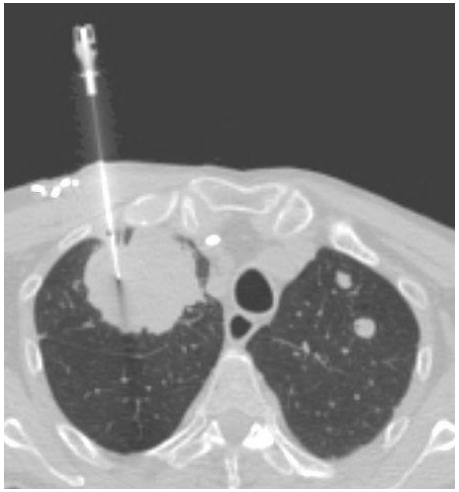


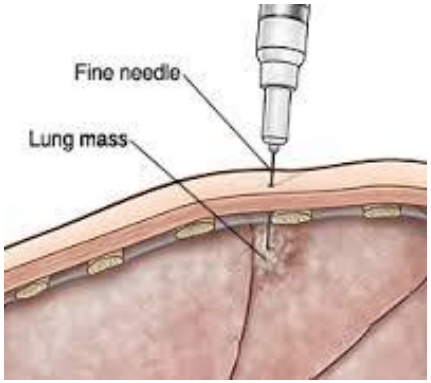
CT fine needle aspiration

- CT-FNA yields high sensitivity values around 90%, with a slightly lower sensitivity of 68–78% for smaller lesions (≤ 15 mm in diameter)

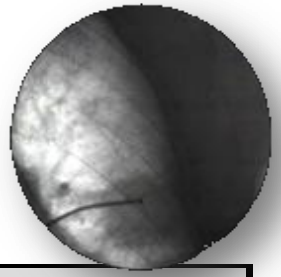
- > 20.5mm traversed length, sensitivity drops further to 59% & complications reach up to 48% (25% pneumothorax, 18% hemorrhage)

Hofmann et al. Clin Lung Cancer 2009
Ost D et al. Chest 2008
Hautmann H et al. Respirology 2010
W. Heerink, Radiology 2016





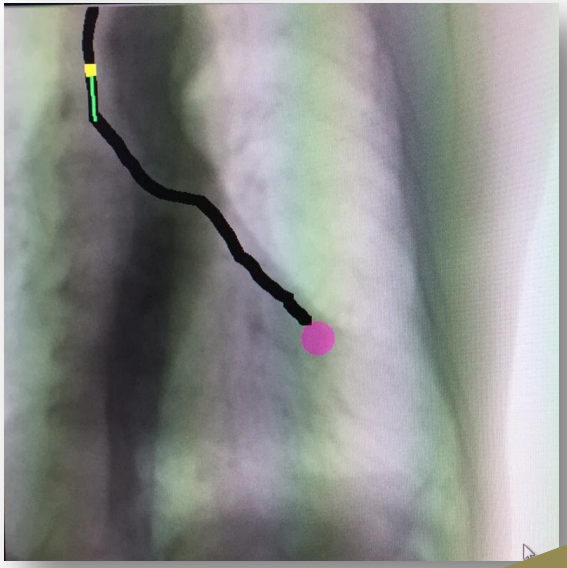
Fluoroscopic guided TBBx

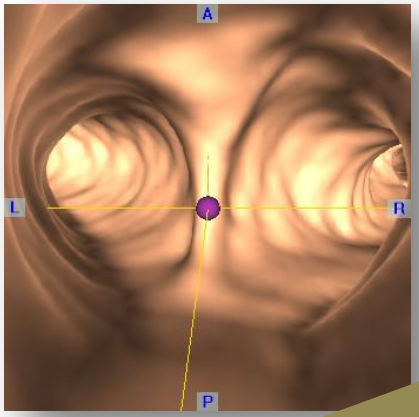


All Methods:		< 2 cm LESION				> 2 cm LESION			
First Author	**Year**	**N**	**Pos**	**Neg**	**Sens**	**N**	**Pos**	**Neg**	**Sens**
Gasparini[110]	1995	195	82	113	**42**	300	169	131	**56**
Hattori[76]	1971	17	13	4	**76**	182	150	32	**82**
Baaklini[88]	2000	16	4	12	**25**	135	93	42	**69**
Wallace[122]	1982	65	3	62	**5**	78	24	54	**31**
Bandoh[130]	2003	25	8	17	**32**	72	50	22	**69**
Radke[106]	1979	21	6	15	**29**	76	49	27	**64**
Naidich[121]	1988	15	4	11	**27**	46	26	20	**57**
Trkanjec[129]	2003	17	9	8	**53**	33	27	6	**82**
McDougall[105]	1981	9	1	8	**11**	36	21	15	**58**
Stringfield[107]	1977	3	1	2	**33**	26	13	13	**50**
Summary		383	131	252	**34**	984	622	362	**63**

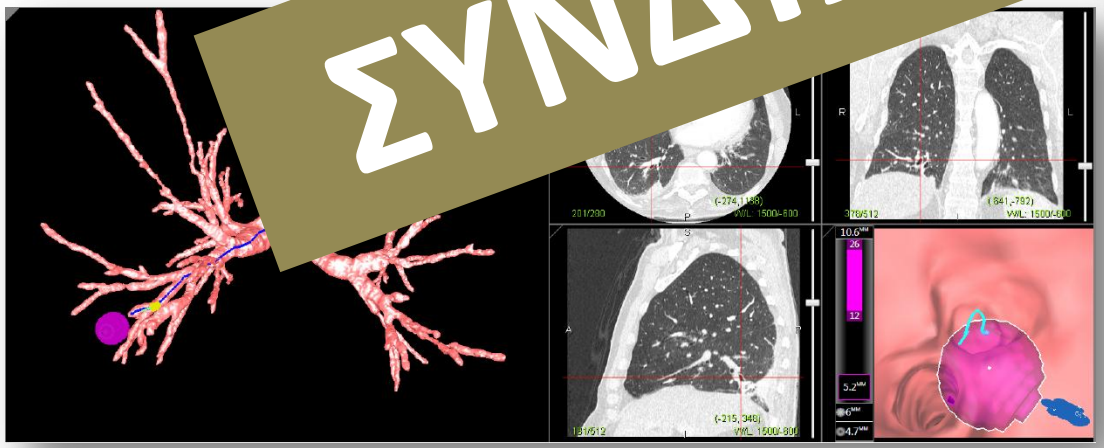
CHEST 2013; 143(5):e142S–e165S

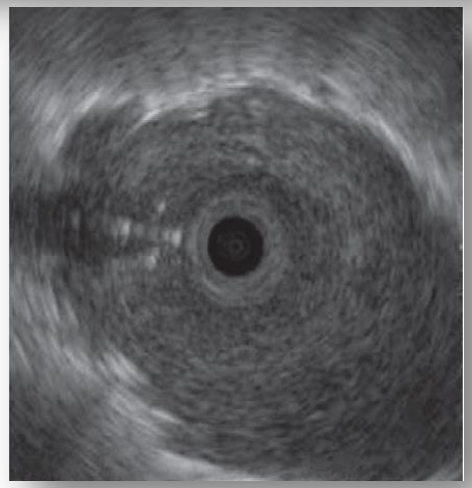
Bronchoscopic guidance techniques





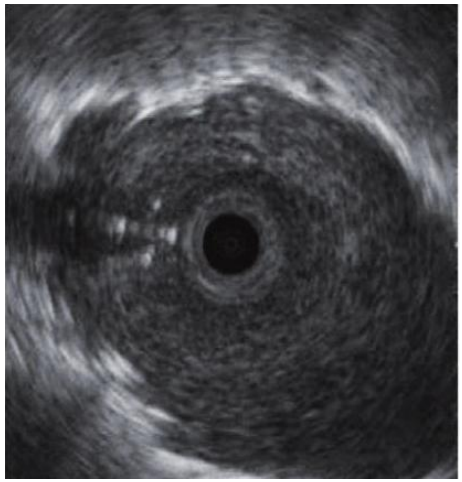
ΣΥΝΔΥΑΣΜΟΣ





Radial Endobronchial Ultrasound

- Biopsy yield is significantly higher when performed within the lesion, rather adjacent to it



Location of the probe	Brushing (140)	TBBx (110)	Total (140)
Within (121)	81/12 (67%)	79/96 (82%)	105/121 (87%)
Adjacent to (19)	7/19 (37%)	1/14 (7%)	8/19 (42%)

Kurimoto et al., Chest 2004;126;959-965

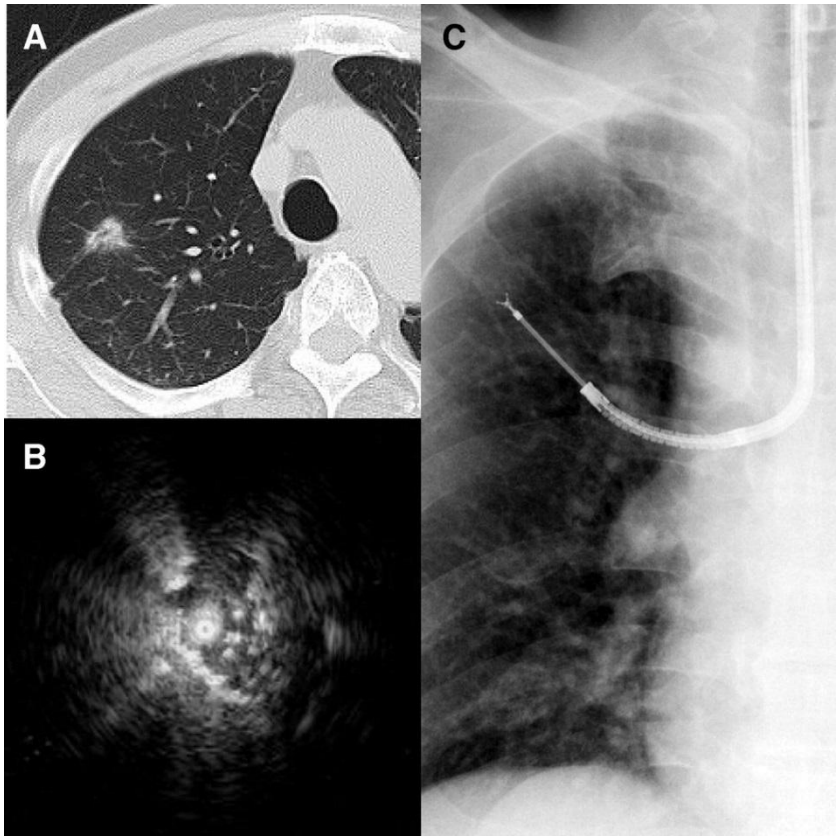
Bronchus sign on chest CT scan can increase the diagnostic yield

Musani et al. Respirology. 2017 Apr;22(3):443-453

Radial EBUS Miniature Probe

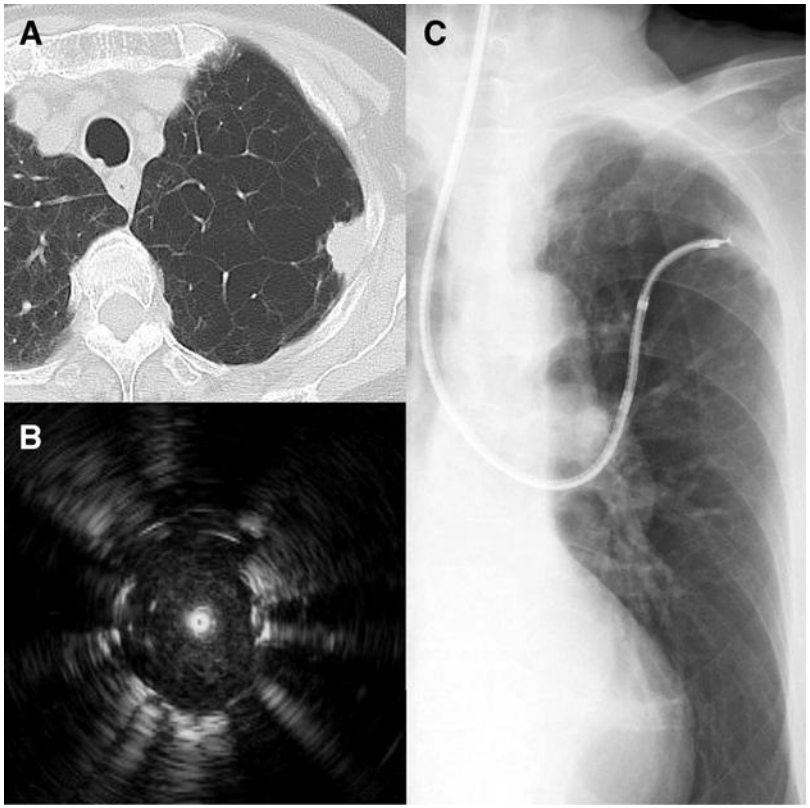
- Ultrasonic imaging via a slim endoscope
- 360° ultrasonic view
- Frequency: 20 MHz
- Detailed ultrasonic images in a thin lumen
- Guide sheath compatible
- Comp. biopsy channel: ≥ 1.7mm (≥ 2.0 mm when used in combination with a Guide sheath)

STANDARD



Thin bronchoscope (4.0 mm and channel 2.0 mm) with rEBUS and sheath

NEW

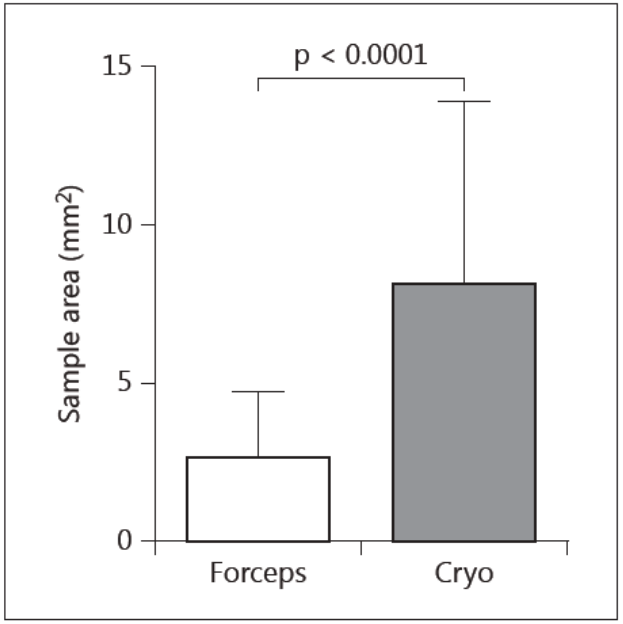


***Ultrathin* bronchoscope (3.0 mm and channel 1.7 mm) with rEBUS mini probe**

A New Tool for Transbronchial Cryobiopsies in the Lung: An Experimental Feasibility ex vivo Study

Respiration 2016;91:228–234

Karl-Josef Franke[a] Walter Linzenbold[b] Daniela Nuessle[b] Markus Enderle[b]
Hans Boesmueller[c] Georg Nilius[a] Jürgen Hetzel[d]



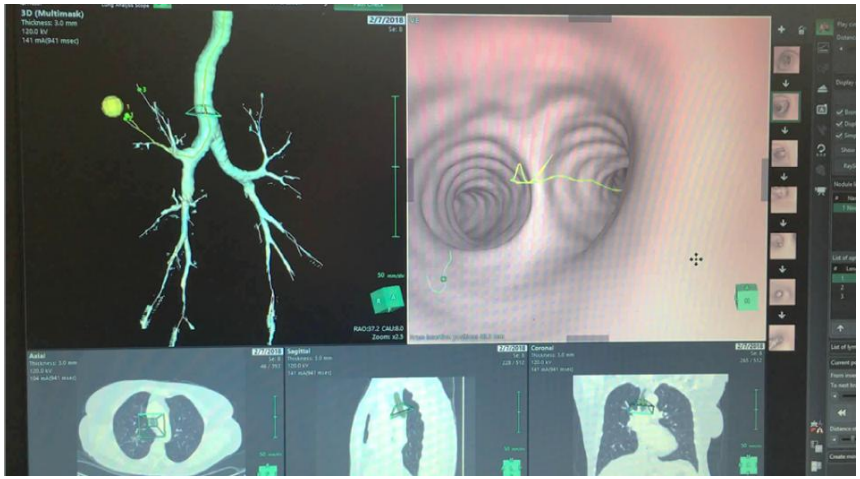
alveolar tissue (53.57 vs. 25.42%; p = 0.0285)

*** Can be retrieved through the working channel**

Συστήματα καθοδήγησης (Navigation systems)

Α. Ηλεκτρομαγνητικής καθοδήγησης

Β. Μη ηλεκτρομαγνητικής καθοδήγησης

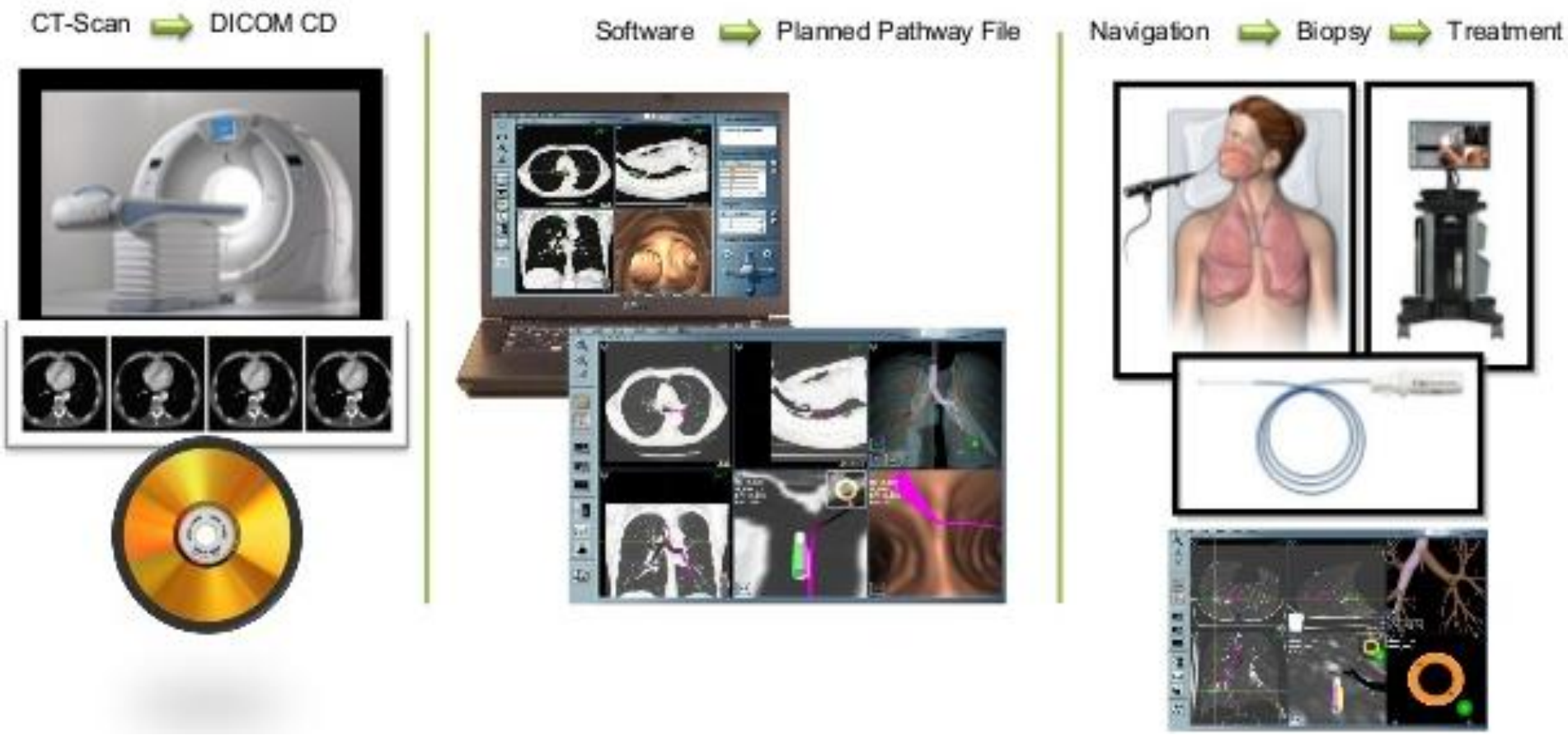


Α. Συστήματα ηλεκτρομαγνητικής καθοδήγησης (EMN systems)

- SuperDimension navigation system – 1995
- Aurora electromagnetic tracking device – 2005
- SPiN Interventional Radiology (IR) – Veran Medical Technologies – 2006

SuperDimension

- 3 basic steps: - Thin section chest CT scan, - Planning of the route, - Bronchoscopy & biopsy



Data on SuperDimension

- Overall diagnostic accuracy: 73.9%

- Positive predicting factors of ENB's yield:
  - ❑ Nodule location in the upper or middle lobes
  - ❑ Greater nodule size
  - ❑ Presence of a bronchus sign on CT imaging (when present: 79%, when absent: 31%)

- Low complication rate

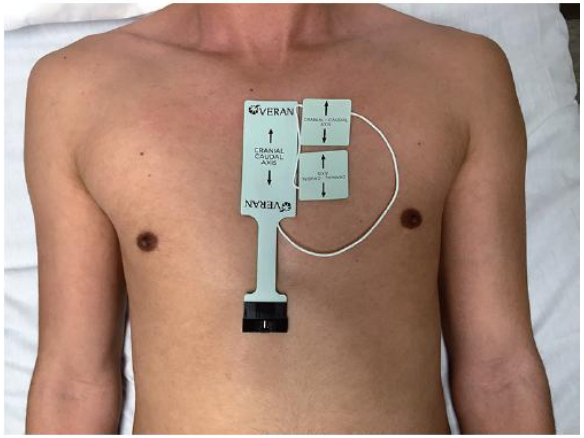
- Higher cost than rEBUS with fluoroscopy

- Lesion position changes with breath movements

Respiration 2014;87:165–176
JOB. 2015 Jan;22(1):5-13
Ann Thorac Med. 2013 Jan;8(1):28-32

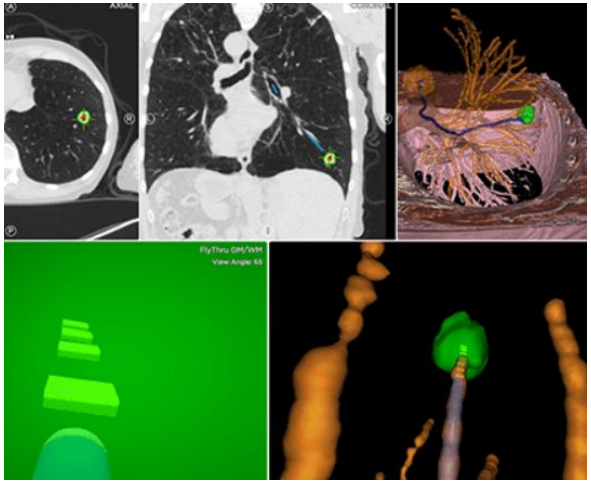
SPiNView Perc™ & Thoracic Navigation System

Generates a 3D map of the lungs based on Veran's Inspiration/Expiration CT Scan Protocol (20x per sec to update respiratory movement) - Automatic recalibration



Laptop-based SPiN Planning™ software converts the scans and creates a dynamic 3D map

Instruments feature electromagnetic sensors that guide and track the path to the target throughout the procedure



SPiNView Perc™ & Thoracic Navigation System

Navigation System

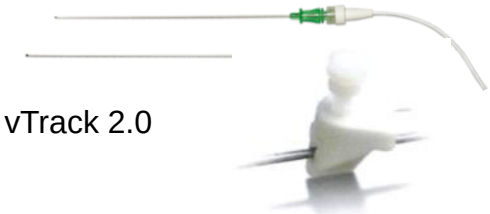
Endobronchial

SPiNFlex

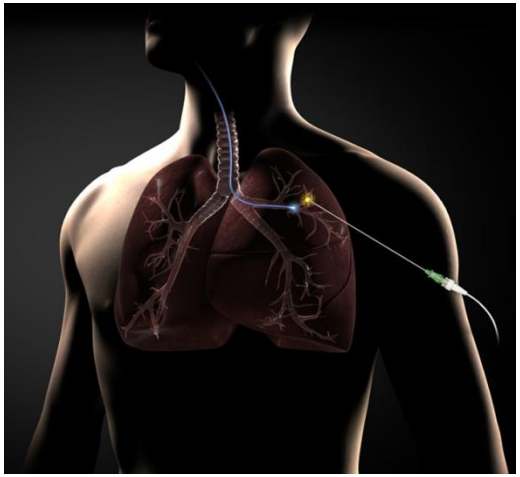
Tip Tracked Instruments

Percutaneous

Needles



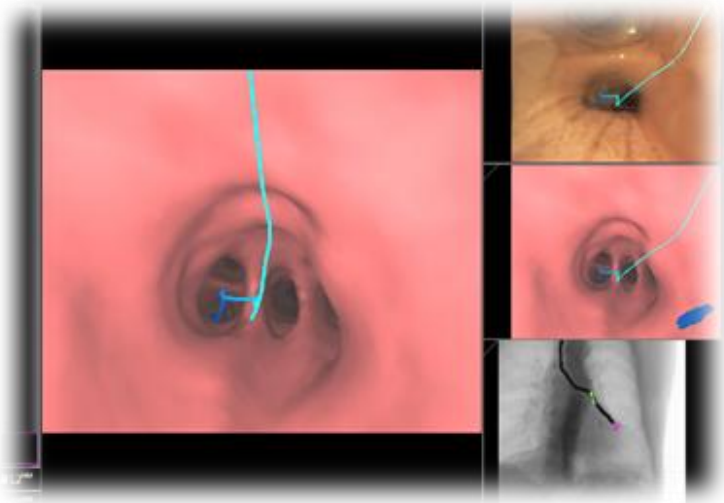
vTrack 2.0



View Peripheral Catheter

Β. Συστήματα μη ηλεκτρομαγνητικής καθοδήγησης

- Broncus Medical, Inc., LungPoint® VBN System
- FUJIFILM Medical Systems, Inc., Synapse® 3D

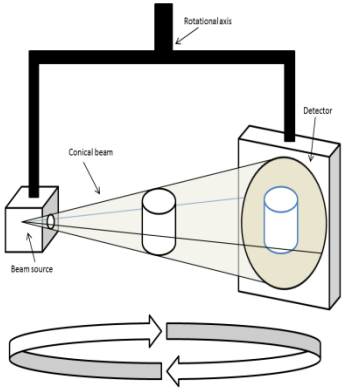


Β. Σύστημα μη ηλεκτρομαγνητικής καθοδήγησης

- Overall diagnostic yield: 73.8%
- For lesions ≤ 2 cm: 67.4% (95% CI 63.3–71.5%)
- **VBN** combined with **ultrathin bronchoscopy**: 65.4–81.6%
- **VBN** with **radial EBUS**: 63.3 - 84.4%
- **VBN** with **X-ray fluoroscopy**: 62.5 - 78.7%

F. Herth et al., Respiration 2014;88:430–440

Conebeam CT Augmented Fluoro & Lung Suite™

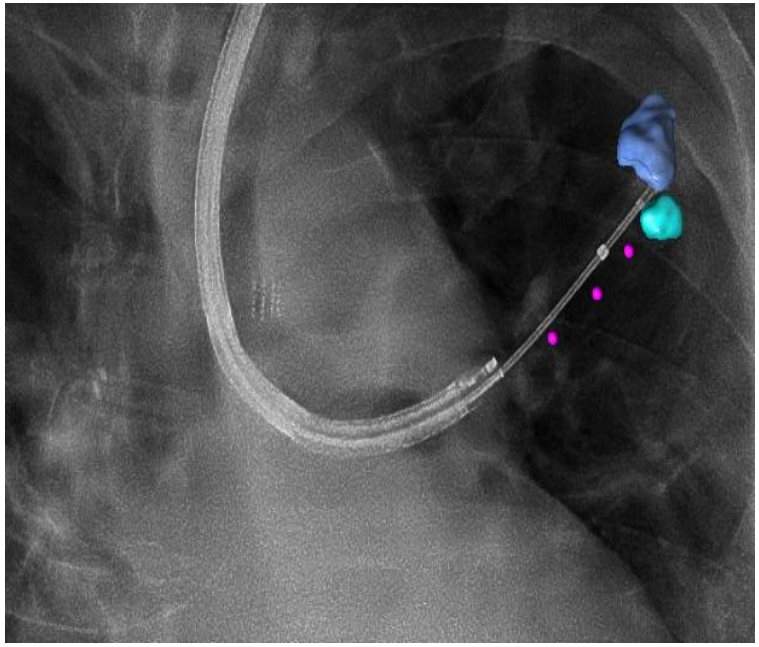


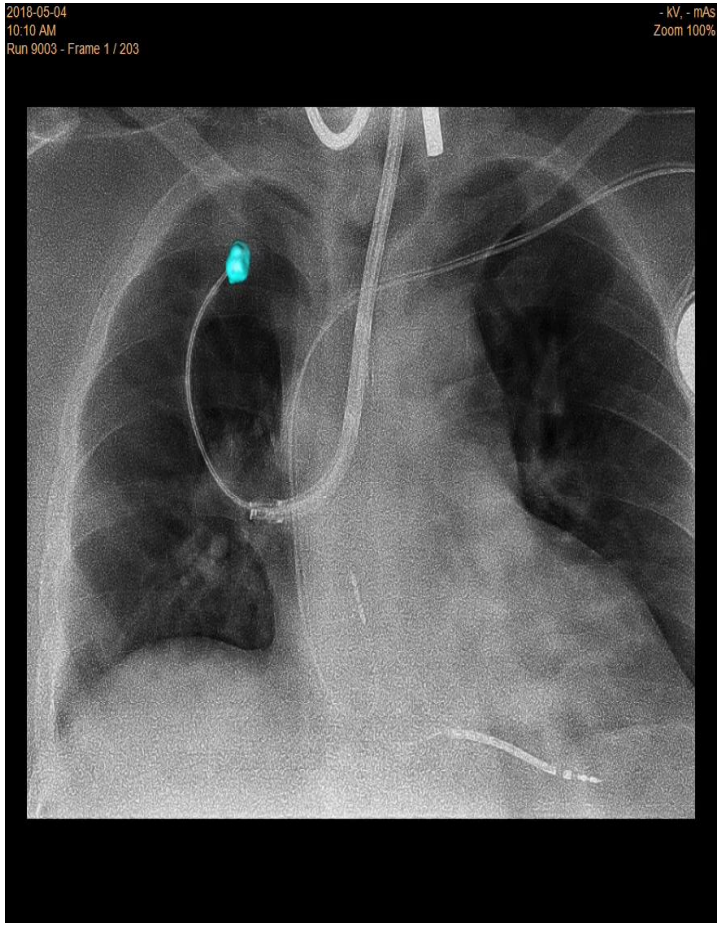
- Cone-beam = C-arm CT
- Target segmentation
- Route navigation
- 3D imaging
- “needle track” / ”bulls-eye” capability

- Freedom of movement for doctor!

Conebeam CT Augmented Fluoro & Lung Suite™

3D-real time image guidance





Courtesy of Dr. E. Van der Heijden

Conebeam CT Augmented Fluoro & Lung Suite™

TABLE 3. Diagnostic Performance of ENB and CBCT With Augmented Fluoroscopy

Diagnostic Performance

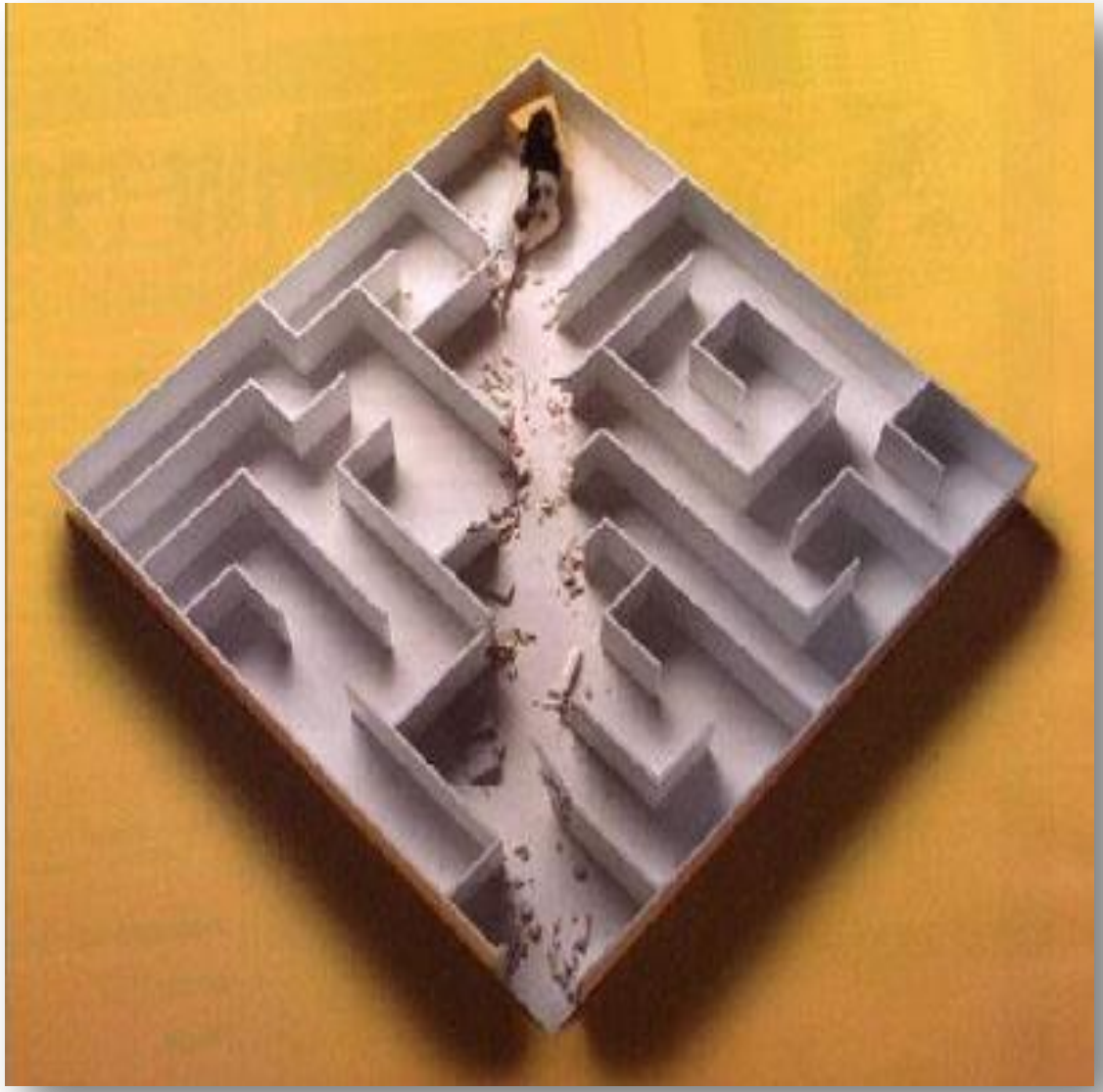
	Diagnostic Yield (95% CI)	Diagnostic Accuracy (95% CI)*
All lesions (n = 92) (mm)	83.7% (74.8%-89.9%)	93.5% (86.5%-97.0%)
Lesions ≤10 (n = 19)	84.2% (62.4%-94.5%)	89.5% (68.6%-97.1%)
Lesions <20 (n = 65)	83.1% (72.2%-90.3%)	90.8% (81.3%-95.7%)
Lesions >20 (n = 27)	96.3% (81.7%-99.8%)	100% (87.5%-100%)
Minimum sensitivity for malignancy†	91.3% (82.3%-96.0%)	
Maximum sensitivity for malignancy‡	95.5% (87.5%-98.4%)	
Minimum prevalence of malignancy‡	71.7% (61.8%-79.9%)	
Maximum prevalence of malignancy†	75.0% (65.3%-82.7%)	
Minimum negative predictive value	79.3% (61.6%-90.2%)	
Maximum negative predictive value	89.7% (73.6%-96.4%)	

J Bronchol Intervent Pulmonol Volume 25, Number 4, October 2018

BTPNA: Bronchoscopic transparenchymal nodule access

Broncus Medical, Inc. - Archimedes™ System

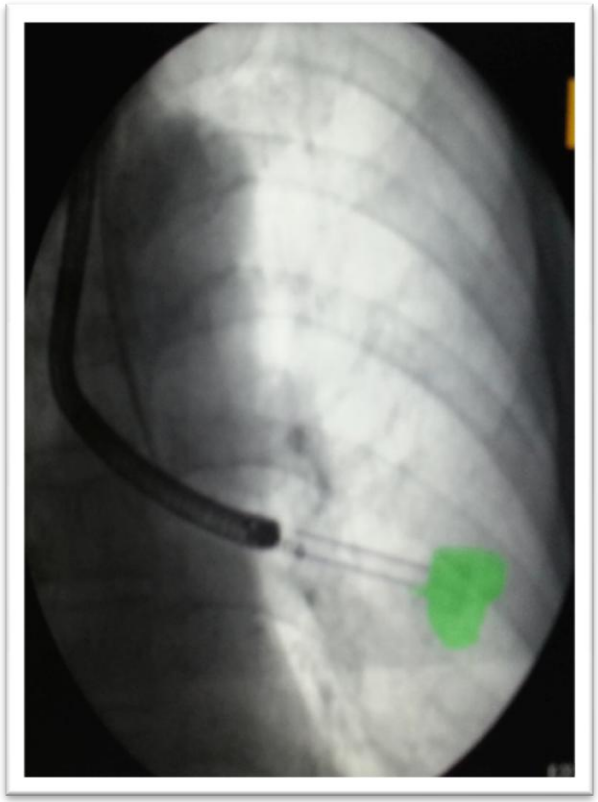
Cross country

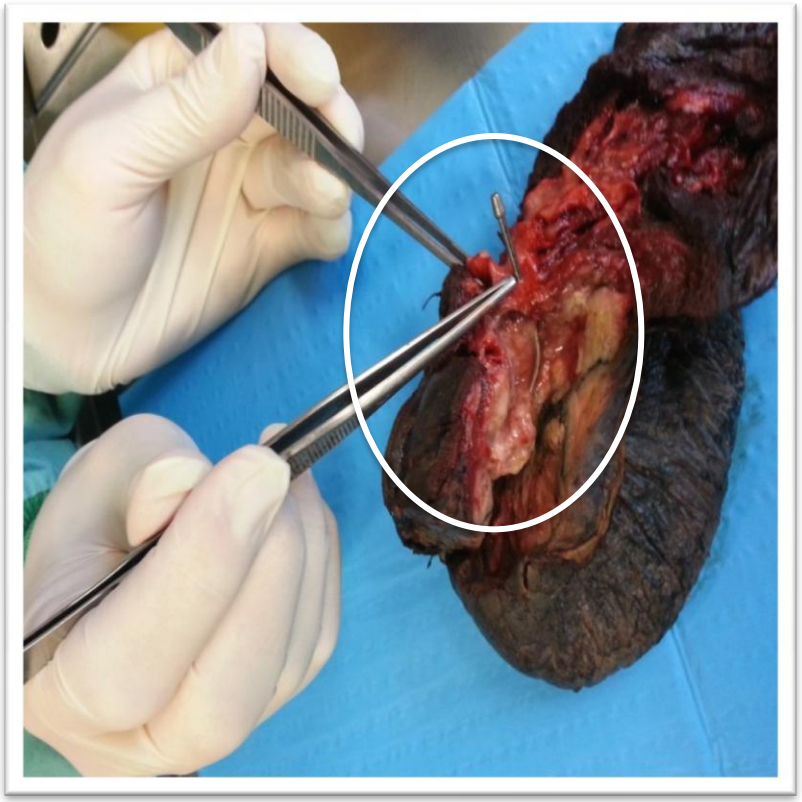


Bronchoscopic transparenchymal nodule access (BTPNA): first in human trial of a novel procedure for sampling solitary pulmonary nodules

Herth FJF, *et al*. *Thorax* 2015;**70**:326–332.

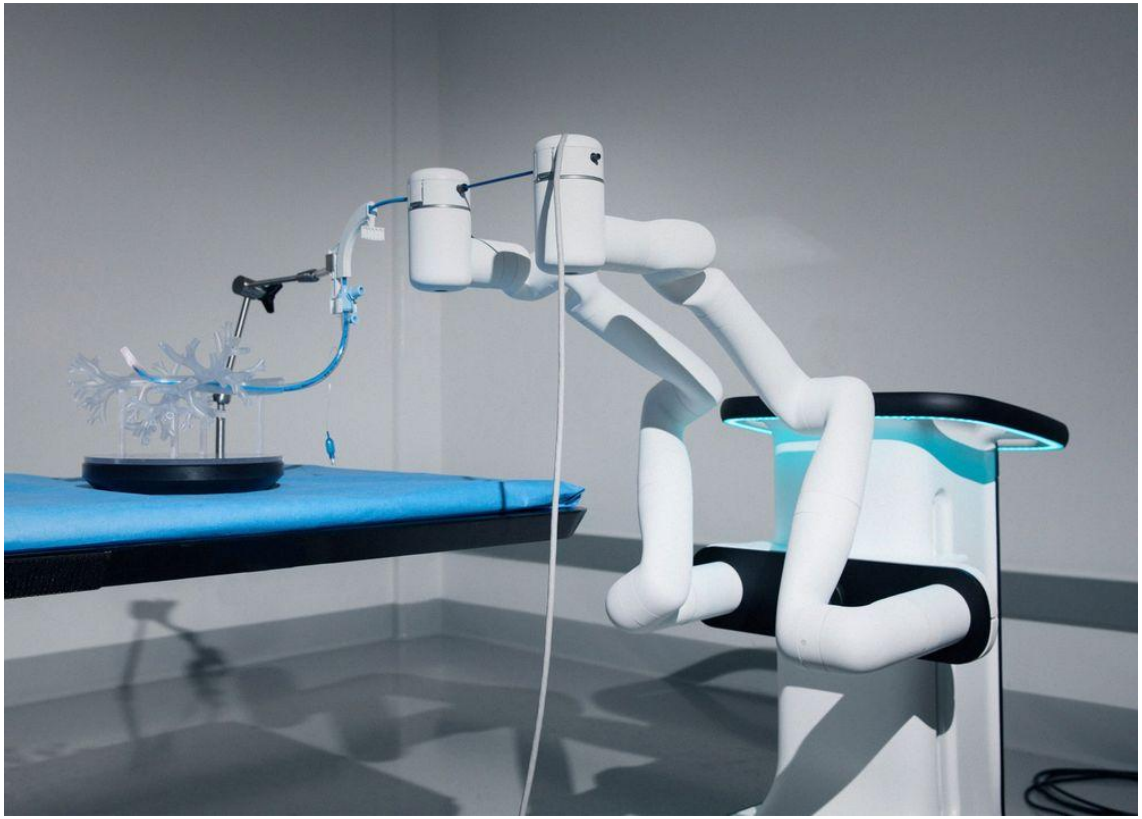
TPNA Human Trial

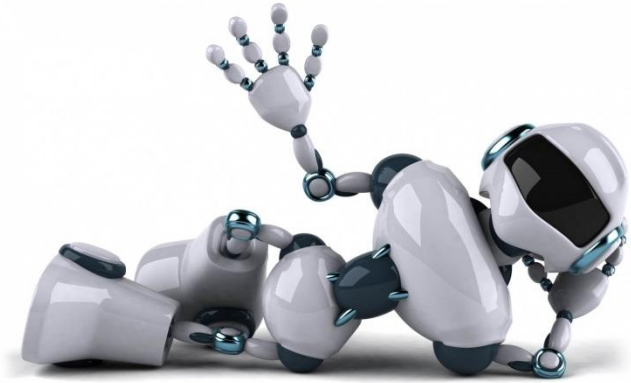


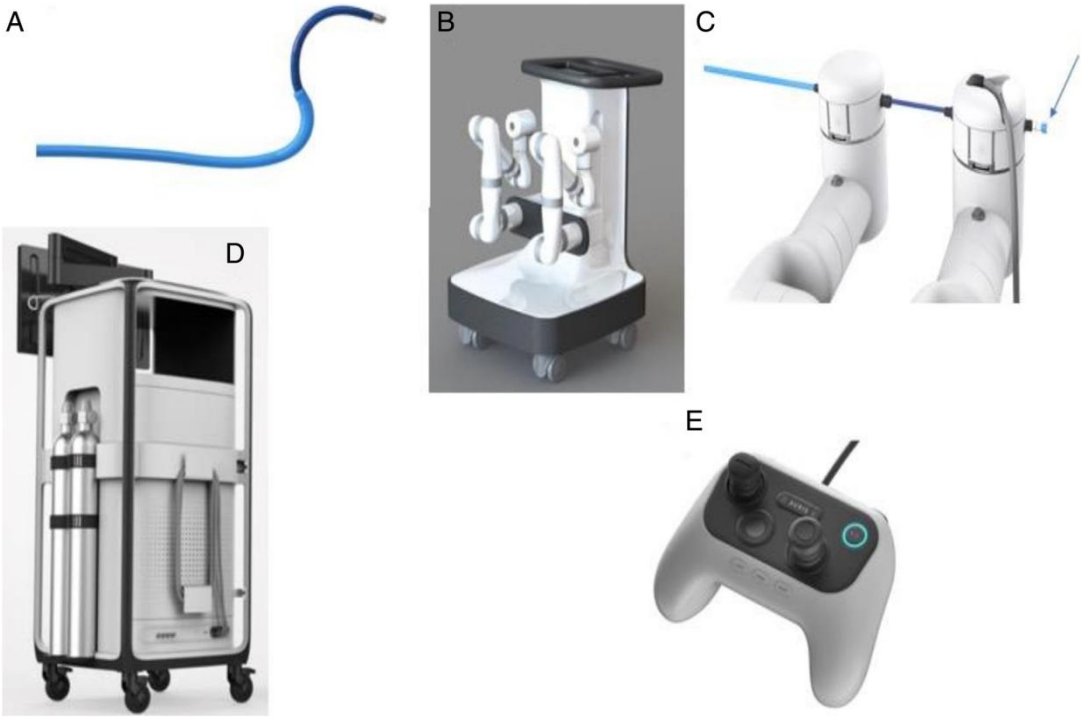


Courtesy of Dr. M. Schumann

Robotic bronchoscopy







S. Murgu BMC Pulmonary Medicine (2019) 19:89

S. Murgu BMC Pulmonary Medicine (2019) 19:89

PRECISION-1 Study

A Prospective Randomized Comparative Study of Three Guided Bronchoscopic Approaches for Investigating Pulmonary Nodules

- Ultrathin scope with radial EBUS (UTBrEBUS) vs EMN vs RB in a human cadaver model of PPN <2cm
- Sixty procedures were performed – 50% had bronchus sign
- Median needle to target "miss" distance was significantly different when comparing UTB-rEBUS, EMN and RB
- RB was superior to EMN

Study Arm	n	Study Outcomes		
		Localization and Puncture *(Primary Endpoint)*[a] % (n)	**Localization & Puncture** *(Secondary Endpoint)*[b] % (n)	**Successful Navigation** % (n)
UTB-rEBUS	20	25 (5)	35 (7)	65 (13)
EMN	20	45 (9)	65 (13)	85 (17)
RB	20	80 (16)	90 (18)	100 (20)

Robotic bronchoscopy

- Πρώιμη φάση ανάπτυξης

- Πλεονεκτήματα:
  - ❑ Μεγαλύτερη ακρίβεια, αυξημένη ευαισθησία
  - ❑ Ικανότητα κινήσεων του περιφερικού καθετήρα στο χώρο

- Μειονεκτήματα:
  - ❑ Κόστος
  - ❑ Μεγάλη καμπύλη εκμάθησης
  - ❑ Απώλεια της «αίσθησης» του οργάνου κατά τη βιοψία

Fielding D., Chest 152,4, A58

NIH U.S. National Library of Medicine

ClinicalTrials.gov

Find Studies ▾ About Studies ▾ Submit Studies ▾ Resources ▾ About Site ▾

Home > Search Results

Modify Search Start Over

Row	Saved	Status	Study Title	Conditions	Interventions	Locations
1	☐	Terminated	Auris **Robotic** Endoscopy System for **Bronchoscopy**	• Lung Cancer	• Device: **Robotic Bronchoscopy** Platform	• El Camino Hospital Mountain View, California, United States • Palo Alto Medical Foundation Mountain View Center Mountain View, California, United States
2	☐	Active, not recruiting	**Robotic Bronchoscopy** for Peripheral Pulmonary Lesions	• Lung; Node	• Device: **Robotic** assisted **bronchoscopy**	• Henry Ford Health System Detroit, Michigan, United States • Washington University School of Medicine Saint Louis, Missouri, United States • Cleveland Clinic Cleveland, Ohio, United States • (and 2 more...)
3	☐	Recruiting	Clinical Utility for Ion Endoluminal System	• Pulmonary Nodule • Lung Cancer • Lung Diseases	• Device: Ion Endoluminal System™	• Massachusetts General Hospital Boston, Massachusetts, United States • Beth Israel Deaconness Medical Center Boston, Massachusetts, United States • Henry Ford Health System Detroit, Michigan, United States • (and 3 more...)
4	☐	Not yet recruiting NEW	Transbronchial Biopsy Assisted by Robot Guidance in the Evaluation of Tumors of the Lung	• Pulmonary Nodule • Lung Cancer	• Device: **Robotic** assisted **bronchoscopy**	• Clinical Research Associates of Central PA Altoona, Pennsylvania, United States
5	☐	Withdrawn	ENB **Robotic** ICG Guided Surgery: A Novel Technique for Targeting Small Lung Tumors	• Non-small Cell Lung Cancer • Thoracic Surgery	• Drug: Indocyanine Green	
6	☐	Withdrawn	Electromagnetic Navigational **Bronchoscopy** Vs. Transthoracic Needle Biopsy for the Sampling of Peripheral Lung Nodules	• Non-small Cell Lung Cancer	• Procedure: Electromagnetic Navigation **Bronchoscopy** • Procedure: Transthoracic Needle Biopsy	

Photo taken by: www.digitallife.gr

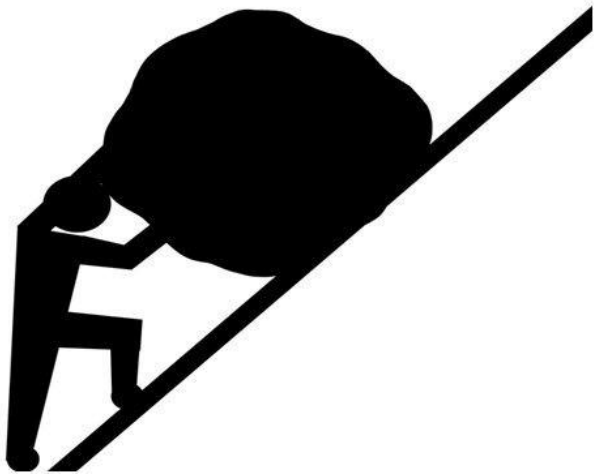


Photo taken by: www.freepng.esp

Photo taken by: www.teambonding.com

Ευχαριστώ για την προσοχή σας